REMARKS

An Excess Claim Fee Payment Letter is attached hereto to cover the cost of the newly added claims.

Claims 1-39 are all the claims presently pending in the application. Claims 1, 5, 22-23, 27 and 31-37 have been amended to more particularly define the invention. Claims 38-39 have been added to claim additional features of the invention. Attached hereto is a marked-up version of the changes made to the specification and claims by the current Amendment.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Applicant gratefully acknowledge that claims 14-19 and 23-36 would be allowable if rewritten to overcome the 35 U.S.C. § 112, second paragraph rejection. However, Applicant respectfully submits that all of the claims are allowable and, therefore, declines to re-write these claims.

Claims 1, 8-10, 20 and 29-37 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Chang et al. (U.S. Patent No. 6,111,673). Claims 36-37 stand rejected based on the same reason as claims 34-35. Claims 2 and 11 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. (U.S. Patent No. 6,111,673) in view of Garnot et al. (M. Garnot et al., "Planning of WDM Networks: Methods, Routing Node Modeling and Applications", IEEE, 1998). Claims 3 and 4 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. and Garnot et al., and further in view of Solgaard et al. (U.S. Patent No. 6,097,859). Claims 5 and 27-28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. (U.S. Patent No. 6,111,673) in view of Domash (U.S. Patent No. 5,937,115). Claim 6 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. and Garnot et al., and further in view of Xu et al. (S. Xu et al., "Dynamic Routing and Assignment of Wavelength Algorithms in Multi-Fiber Wavelength Algorithms in Multi-Fiber Wavelength Division Multiplexing Networks", Proceedings of Eight

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International Conference on Computer Communications and Networks, October 1999). Claim 7 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al., Garnot et al. and Solgaard et al., and further in view of Xu et al. Claims 12-13 and 21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. (U.S. Patent No. 6,111,673) in view of Xu et al. Claim 22 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. and Xu et al., and further in view of Domash (U.S. Patent No. 5,937,115).

These rejections are respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

The claimed invention is directed to an optical switch (and method) for a network having a plurality of nodes. The inventive optical switch includes a switch coupled to communications links used for input and output in which a plurality of wavelengths are used to carry traffic on a communications link, and a controller, coupled to the switch, for controlling the operation of the switch by implementing a routing protocol, and implementing a labeling protocol that associates a label with a destination, said label comprising at least one of a wavelength and a fiber number. The controller controls the switch to direct the various wavelengths of traffic from an input link to an appropriate output link as determined by the routing protocol and the labeling protocol.

Conventional systems include label switching routers (LSRs) having a router/switch controller (RSC) and a label swapping switch (e.g., an asynchronous transfer mode (ATM switch). The RSC exchanges Internet Protocol (IP) routing information with other routers via standard routing protocols and forwards IP packets based on the acquired routing information. The RSC also controls the label swapping switch. However, such routers require a packet header on the data packet which necessitates electronics in the data path in order to route optical signals, resulting in an "electronic bottleneck".

The claimed optical switch, on the other hand, implements a labeling protocol that associates a label with a destination, the label including a wavelength and/or a fiber number. Unlike an LSR, the inventive optical switch uses optical technology to route the different

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wavelengths in different directions. Therefore, unlike conventional systems, the claimed optical switch does not require a packet header on the data packet which avoids electronics in the data path and, thus, eliminates the "electronic bottleneck" present in conventional systems.

II. THE PRIOR ART REFERENCE

A. The Chang Reference

The Examiner alleges that Chang teaches the claimed invention. Applicant submits, however, that there are elements of the claimed invention which are neither taught nor suggested by Chang.

Chang discloses an optical signaling header technique applicable to optical networks, wherein packet routing information is embedded in the same channel or wavelength as the data payload so that both the header and data payload propagate through network elements with the same path and the associated delays (Chang at Abstract).

However, Chang does not teach or suggest a controller which may control a switch by "implementing a labeling protocol that associates a label with a destination, said label comprising at least one of a wavelength and a fiber number", as recited in claims 1 and 31. As noted above, conventional systems such as Chang include label switching routers (LSRs) having a router/switch controller (RSC) and a label swapping switch (e.g., an asynchronous transfer mode (ATM switch) (Application at page 7, line 19-page 8, line 6). The RSC exchanges Internet Protocol (IP) routing information with other routers via standard routing protocols and forwards IP packets based on the acquired routing information. The RSC also controls the label swapping switch. However, such routers require a packet header on the data packet which necessitates electronics in the data path in order to rout optical signals, resulting in an "electronic bottleneck" (Application at page 10, lines 15-18).

The claimed optical switch, on the other hand, implements a labeling protocol that associates a label with a destination, the label including at least one of a wavelength and a fiber number, (Application at page 18, line 17-page 19, line 4). Unlike an LSR, the inventive optical switch uses optical technology to route the different wavelengths in different

directions. Therefore, unlike conventional systems, the claimed optical switch does not require a packet header on the data packet (i.e., does not encode the label into the optical signal) which avoids electronics in the data path and, thus, eliminates the "electronic bottleneck" present in conventional systems (Application at page 4, lines 4-7).

Clearly, Chang does not teach or suggest these novel features. Indeed, on page 4 of the Office Action, the Examiner specifically, states that "Chang et al. encodes the label into the optical signal" (i.e., requires packet header on the data packet), and therefore, concedes that Chang does not teach or suggest the novel features of the invention.

Specifically, the design of the claimed invention differs from Chang's in significant ways. For example, the invention does not use an explicit packet header for each packet. This is important for several reasons.

For example, the claimed invention avoids processing of each packet which allows the invention to avoid the "electronic bottleneck" as described in the Application. This allows the claimed invention to minimize delay through a network.

Chang, on the other hand, teaches adding about 2 km (i.e. more than a mile) of fiber on each input port of switching device 430 so that a packet will be delayed by "about 10 microseconds" to allow for enough time to determine how the packet should be routed and change the state of the switch if necessary (Chang at in col. 10, lines 1-8). And this extra 2 km of fiber / 10 microsecond delay is repeated at each node in the network.

Applicant also notes that Chang teaches an incoming optical fiber 602 with a delay loop 603 (Chang at col.12, line 39). Furthermore, as noted above, the delay loop is a spool of fiber 2 km long. The claimed invention, on the other hand, does not need a delay loop to perform any processing for each packet in "electronics". The claimed invention can also provide much more throughput in addition to having significantly less delay.

The claimed invention also has other advantages over the Chang scheme. For instance, Chang describes a portion of the light energy coming into an input port "is tapped .. and inputted to" another module which processes the input packet to detect the header so the header can be processed (Chang at col. 12, line 44). This means that the Chang scheme will lose light energy at each hop, which is not the case in the claimed invention.

Applicant also notes that Chang states that "[t]his tag switching normally occurs on a packet-by-packet basis" (Chang at col. 13, line 43). Chang also makes the point that "it is inefficient for each particular network element to carefully examine each tag and decide on the routing path" (Chang at col. 13, line 49). Applicant notes that this may be correct, which is why the claimed invention does not examine tags at each network element.

Moreover, the optimization suggested by Chang is inferior to the claimed invention. Specifically, Chang states that "[t]ypically however a large number of packets will be sequentially transported toward the same destination" (Chang at col. 13, line 45). Applicant notes that this is not really true in real world networks. It may be true that a source may send a burst of packets, but by the time these packets get into the heart of the network, they will typically be interleaved with many other packets coming from lots of other sources going to many other destinations. Therefore, the optimization that Chang describes for setting up and tearing down "virtual circuits" does not appear to be very useful in a real world network.

In contrast to Chang, the claimed invention can efficiently handle the large numbers of distinct flows that occur in a real world network. Even if Chang combines the notion of using tag switching (or MPLS as this has become more commonly known) with optical transmission, like the original (e.g., conventional) proposals for tag switching and MPLS, Chang must perform "electronic processing" on most packets. Applicant also points out that the original tag switching and MPLS documents also disclose using tag switching/MPLS with optical transmission.

However, the claimed invention is significantly different since it eliminates packet headers as well as the processing that other (e.g., conventional) schemes must perform on these packet headers and thus eliminates this "electronic bottleneck". This is significant since it allows the claimed invention to minimize network delays and greatly increase network throughput. Moreover, since the claimed invention is not subject to the "electronic bottleneck" of conventional switches, it allows the claimed invention to make use of the enormous traffic handling capacity of optical fiber.

On page 3 of the Office Action, the Examiner states "[r]egarding claims 1 and 31, Chang et al. discloses .... and headers that are carried along with data". However, as

explained above, the claimed invention does not require headers "that are carried along with data" and thus, the claimed invention does not have to perform any header processing which, as noted above, is very important.

Unlike Chang, the claimed invention combines the notion of MPLS with optical switching, and uses (in one embodiment) wavelengths of light as an "implicit" label. In other variations, the claimed invention may use a fiber number or the combination of a wavelength of light and a fiber number as an implicit label. In still another variation, the claimed invention may use the combination of a more generalized "virtual fiber" and a "virtual color" as an implicit label, as described, for example, on page 19 of the Application.

Also on page 3 of the Office Action, the Examiner states "[r]egarding claim 20, Chang et al. discusses the optical technology in col 19, lines 8-55. The data path of the switching system is all-optical". Applicant submits, however, that the data path in Chang's scheme may be all optical "in one sense," but there are significant delays for header processing which is why Chang has an extra 2 kilometers of fiber on each input port so that he has time to do his header processing. Thus, even assuming that in some sense there may not be electronics in Chang's data path, there is still significant delay in his data path to accommodate the processing that he needs to do on a packet header.

Therefore, Applicant submits that Chang does not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection of claims 1, 8-10, 20 and 29-37 based on Chang.

B. The Garnot Reference

Regarding claims 2 and 11, the Examiner alleges that Garnot would have been combined with Chang to form the claimed invention. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Garnot discloses a Wavelength-Division Multiplexing (WDM) technique in a transport network. Specifically, a Wavelength Routing (WR) scheme is disclosed in which an optical path is assigned a single wavelength from end to end (Garnot at page 353).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different matters. Specifically, Chang is directed to an optical signaling header technique where packet routing information is embedded in the same channel or wavelength as the data payload (Chang at Abstract). In other words, the Chang device specifically requires packet headers and, in fact, would be ineffective without such packet headers.

Garnot, on the other hand, discloses a wavelength routing scheme where an optical path is assigned a single wavelength from end to end. In other words, Garnot is completely unrelated to the packet header technique of Chang. Moreover, the WR system of Garnot operates in a manner that is directly counter to the function of the packet header technique of Chang. Therefore, no person of ordinary skill in the art would have considered combining these references.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, the Examiner supports the combination by merely stating that "[i]t would have been obvious ... to assignment [sic] multiple wavelengths to a destination, as taught by Garnot et al., in the switching system of Chang et al. to avoid blocking without using wavelength conversion" which is merely a conclusory statement and insufficient to support the combination.

Moreover, Garnot, like Chang, does not teach or suggest a controller which may control a switch by "implementing a labeling protocol that associates a label with a destination, said label comprising at least one of a wavelength and a fiber number" as recited in claim 1. As noted above, unlike conventional systems which use routers which require a packet header on the data packet which necessitates electronics in the data path in order to rout optical signals, resulting in an "electronic bottleneck" (Application at page 10, lines 15-18), the claimed optical switch implements a labeling protocol that associates a label with a destination, said label comprising at least one of a wavelength and a fiber number, (Application at page 18, line 17-page 19, line 4).

Unlike an LSR, the inventive optical switch uses optical technology to route the different wavelengths in different directions. Therefore, unlike conventional systems, the

claimed optical switch does not require a packet header on the data packet (i.e., does not encode the label into the optical signal) which avoids electronics in the data path and, thus, eliminates the "electronic bottleneck" present in conventional systems (Application at page 4, lines 4-7).

Clearly, Garnot does not teach or suggest these novel features. Indeed, Garnot merely teaches a WDM system in which "an optical path is assigned a single wavelength from end to end" (Garnot at page 353). However, Garnot does not disclose any form of labeling protocol. For instance, Garnot does not disclose an IP destination or an IP address. Garnot merely discloses routing assigning a wavelength to an optical path.

Further, Garnot does not disclose controlling an optical switch. In other words, Garnot does not disclose a controller coupled to a switch, let alone a controller which controls the switch by implementing a labeling protocol that associates a label with a destination, said label comprising at least one of a wavelength and a fiber number. Therefore, Garnot does not make up for the deficiencies of Chang.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

C. The Solgaard Reference

Regarding claims 3 and 4, the Examiner alleges that Solgaard would have been combined with Chang and Garnot to form the claim invention. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Solgaard discloses a cross-connect switch for fiber-optic communication networks. The switch includes a wavelength dispersive element, such as a grating, and a stack of regular (non-wavelength selective) cross bar switches using two-dimensional arrays of micro-machined, electrically actuated, individually-tiltable, controlled deflection micro-mirrors for providing multiport switching capability for a plurality of wavelengths (Solgaard at Abstract).

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However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different matters. Specifically, Solgaard is intended to provide a fiber-optic switch using two arrays of actuated mirrors to switch or rearrange signals from N input fibers onto N output fibers, where N can be larger than 2 (Solgaard at col. 1, lines 63-67), whereas Chang, as noted above is directed to an optical signaling header technique, and Garnot discloses a wavelength routing scheme. In other words, Garnot and Chang are completely unrelated to the cross-connect optical switch in Solgaard. Therefore, no person of ordinary skill in the art would have considered combining these references.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, the Examiner supports the combination by merely stating that "[i]t would have been obvious ... to use MEMS for the switching device, as taught by Solgaard et al., in the modified switching system of Chang et al. and Garnot et al. because MEMS technology is capable of building large cross-connects" which is merely a conclusory statement and insufficient to support the combination.

Moreover, Solgaard, like Garnot and Chang, does not teach or suggest a controller which may control a switch by "implementing a labeling protocol that associates a label with a destination, said label comprising at least one of a wavelength and a fiber number" as recited in claim 1. As noted above, the claimed optical switch implements a labeling protocol that associates a label with a destination, the label including a wavelength and/or a fiber number (Application at page 18, line 17-page 19, line 4). Unlike an LSR, the inventive optical switch uses optical technology to route the different wavelengths in different directions. Therefore, unlike conventional systems, the claimed optical switch does not require a packet header on the data packet (i.e., does not encode the label into the optical signal) which avoids electronics in the data path and, thus, eliminates the "electronic bottleneck" present in conventional systems (Application at page 4, lines 4-7).

Clearly, Solgaard does not teach or suggest these novel features. Indeed, Solgaard merely teaches a micromirror array 74 which is a one-dimensional array with one mirror per

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wavelength (Solgaard at col. 9, lines 21-22). However, Solgaard states that the mirror would have two states, sending a corresponding wavelength to an output fiber, or tilted to send a wavelength to the detector 76 (Solgaard at col. 9, lines 22-26). Moreover, Solgaard does not disclose a controller for controlling a switch (e.g., controlling the micromirror array 74).

In other words, Solgaard does not disclose a controller coupled to a switch, let alone a controller which controls the switch by implementing a labeling protocol that associates a label with a destination, said label comprising at least one of a wavelength and a fiber number, . Therefore, Solgaard does not make up for the deficiencies of Chang and Garnot.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

D. The Domash Reference

Regarding claims 5 and 27-28, the Examiner alleges that Domash would have been combined with Chang to form the claimed invention. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Domash discloses optical components or nodes which are formed utilizing holographically polymerized polymer/liquid crystal composites. In a preferred embodiment, guided wave optical paths, and in particular waveguides, are utilized for node interconnects, with various techniques being presented for forming nodes and/or structures as integrated optical structures (Domash at Abstract).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different matters. Specifically, Domash is directed to an electronically switchable Bragg Grating element and electrodes for selectively applying an electric field across the element (Domash at col. 3, lines 40-45), whereas Chang, as noted above is directed to an optical signaling header technique. In other words, Domash and Chang are completely unrelated. Therefore, no person of ordinary

skill in the art would have considered combining these references.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, the Examiner supports the combination by merely stating that "[i]t would have been obvious ... to use light steering optical switch, as taught by Domash, in the switching system of Chang et al. because it is reliable" which is merely a conclusory statement and insufficient to support the combination.

Moreover, Domash, like Chang, does not teach or suggest a controller which may control a switch by "implementing a labeling protocol that associates a label with a destination, said label comprising at least one of a wavelength and a fiber number, " as recited in claim 1. As noted above, the claimed optical switch implements a labeling protocol that associates a label with a destination. Specifically, the label may include a wavelength and/or a fiber number, (Application at page 18, line 17-page 19, line 4).

Clearly, Domash does not teach or suggest these novel features. Indeed, Domash merely teaches a design for a Bragg grating element (Domash at Figure 1). Domash is completely unconcerned with a controller for controlling a switch. Specifically, referring to Figure 4, Domash merely states that "signals from a suitable control applied across the leads 24 producing a desired electric field across the ESBG" (Domash at col. 9, lines 49-51).

In other words, Domash does not disclose a controller coupled to a switch, let alone a controller which controls the switch by implementing a labeling protocol that associates a label with a destination, the label including a wavelength and/or a fiber number, . Therefore, Domash does not make up for the deficiencies of Chang.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

F. The Xu Reference

The Examiner alleges that Xu would have been combined with Chang and Garnot to

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form the invention as claimed in claim 6, with Chang, Garnot and Solgaard to form the invention as claimed in claim 7, with Chang to form the invention as claimed in claim 12-13 and 21, and with Chang and Domash to form the invention as claimed in claim 22. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Xu discloses a layered-graph-based routing and assignment of wavelength (RAW) algorithm for dynamic routing and assignment of wavelength in WDM networks. Specifically, by virtue of layered-graph, routing and assignment of wavelength subproblems can allegedly be considered simultaneously (Xu at Abstract).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different matters. Specifically, Xu is intended to provide a shortest path algorithm which is less complex than standard shortest path algorithms, whereas Solgaard is intended to provide a fiber-optic switch using two arrays of actuated mirrors to switch or rearrange signals, Chang, as noted above is directed to an optical signaling header technique, Garnot discloses a wavelength routing scheme, and Domash is directed an electronically switchable Bragg Grating element. In other words, Xu is completely unrelated to the other references. Therefore, no person of ordinary skill in the art would have considered combining these references.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. For example, with respect to claim 6, the Examiner supports the combination by merely stating that "[i]t would have been obvious ... to use multiple fibers between node pairs and maintain the same wavelength throughout a lightpath, as taught by Xu et al. ... to eliminate wavelength converters" which is merely a conclusory statement and insufficient to support the combination.

Moreover, Xu like the other references does not teach or suggest a controller which may control a switch by "implementing a labeling protocol that associates a label with a destination, said label comprising at least one of a wavelength and a fiber number, " as recited in claim 1. As noted above, the claimed optical switch implements a labeling protocol that

associates a label with a destination, the label including a wavelength and/or a fiber number, (Application at page 18, line 17-page 19, line 4).

Clearly, Xu does not teach or suggest these novel features. Indeed, as noted above, Xu merely discloses a layered-graph-based routing and assignment of wavelength (RAW) algorithm for dynamic routing and assignment of wavelength in WDM networks. Specifically, Xu discloses a node having an optical switch which is dynamically configurable (Xu at page 332) and multiple fibers between node pairs (Xu at page 332). However, Xu does not disclose a controller for controlling a switch in the optical switch.

In other words, Xu does not disclose a controller coupled to a switch, let alone a controller which controls the switch by implementing a labeling protocol that associates a label with a destination, the label including a wavelength and/or a fiber number. Therefore, Xu does not make up for the deficiencies of Chang, Garnot, Solgaard or Domash.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

III. FORMAL MATTERS AND CONCLUSION

Submitted herewith are Proposed Drawing Corrections which address the concerns of the Examiner. Specifically, Figures 1-3 have been designated as prior art and Figure 5B has been amended to describe the boxes illustrated therein. In addition, Figure 5A has been amended to identify the controller 56 as disclosed by the specification.

In view of the foregoing, Applicant submits that claims 1-39, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

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The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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